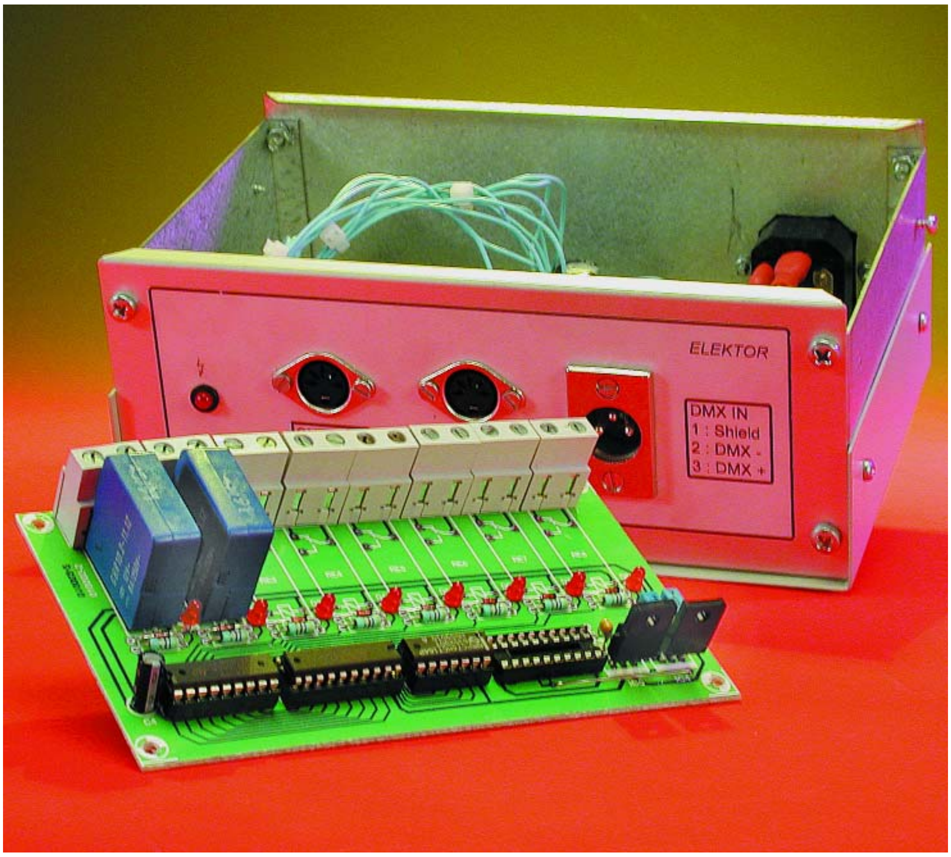
Relay Extension for DMX Demultiplexer

eight DMX channels for eight relays

Design by B. Bouchez

The DMX demultiplexer, which was described in *Elektor Electronics* recently, enables you to drive eight analogue outputs with a control voltage from 0 to 10 V, a standard that is used for many lighting installations. For less elaborate equipment, such a control voltage is not actually necessary, since the control is limited to either 'on' or 'off'. This is the intended application for this extension circuit which provides eight relay outputs.



The remote control of lighting installations with voltage or current is still very common nowadays, despite the existence of DMX512. In all likelihood either because the design is quite old (dimmers mostly), or because it is equipment where the additional costs of a digital interface would be unjustifiable (stroboscopes, smoke generators). This was one of the motivations for designing the 8-channel DMX/10-V interface, which is able to control such equipment directly (refer to *Elektor Electronics* November 2001).

There is also equipment out there that requires even less elaborate control, in the form of a simple contact closure. Controlling such equipment with the demultiplexer is not very complicated (a transistor circuit that drives a relay when the voltage is greater than some threshold will suffice). Such a solution is not very attractive from an economic perspective however, particularly because of the presence of an 8-channel DAC, which has effectively become unemployed.

The author, therefore, has designed this small extension that makes the DAC and accompanying circuitry unnecessary and replaces it with an inexpensive digital circuit that drives a relay instead.

Before we move on, we have to point out two important facts. Firstly, the use of this interface precludes the option of using the DAC (it is either one or the other). It is not possible to mix the analogue outputs from the DAC with the digital outputs from the relay extension in the same multiplexer.

Secondly, readers who have already built the analogue version need not make a single change to the circuit. All necessary modifications have already been incorporated in the published version, both from a programming perspective as well as from a hardware perspective. It is actually enough to remove the DAC8800 from its socket, replace it with the ribbon cable connector from the relay extension and to flip a configuration DIP switch to indicate to the program that we wish to use the relay extension.

The circuit

As can be observed from **Figure 1**, this relay extension can definitely not be accused of being terribly complicated! There is hardly anything there, apart from some very common ICs.

The interconnection to the main circuit board is simply accomplished with a ribbon cable, fitted with a DIL-header that plugs in the location previously occupied by the DAC8800 on the demultiplexer PCB. The ribbon cable attached to this DIL connector carries all signals, including the power supply, which are necessary for the extension circuit.

Normally, the DAC8800 is driven with a serial data stream from the microprocessor. IC1 is present to convert this data stream into a useful format: 8 bits parallel.

It is the task of IC2 to latch the data on the data lines at the instant that the microprocessor communicates with IC1. Once the 8 bits are loaded into IC1, signal LD ‘freezes’ the parallel data obtained.

The outputs from IC2 are not capable of driving a relay directly. This is why an octal buffer IC type ULN2803 sits between the relay coils and IC2.

Each relay output is also provided with an

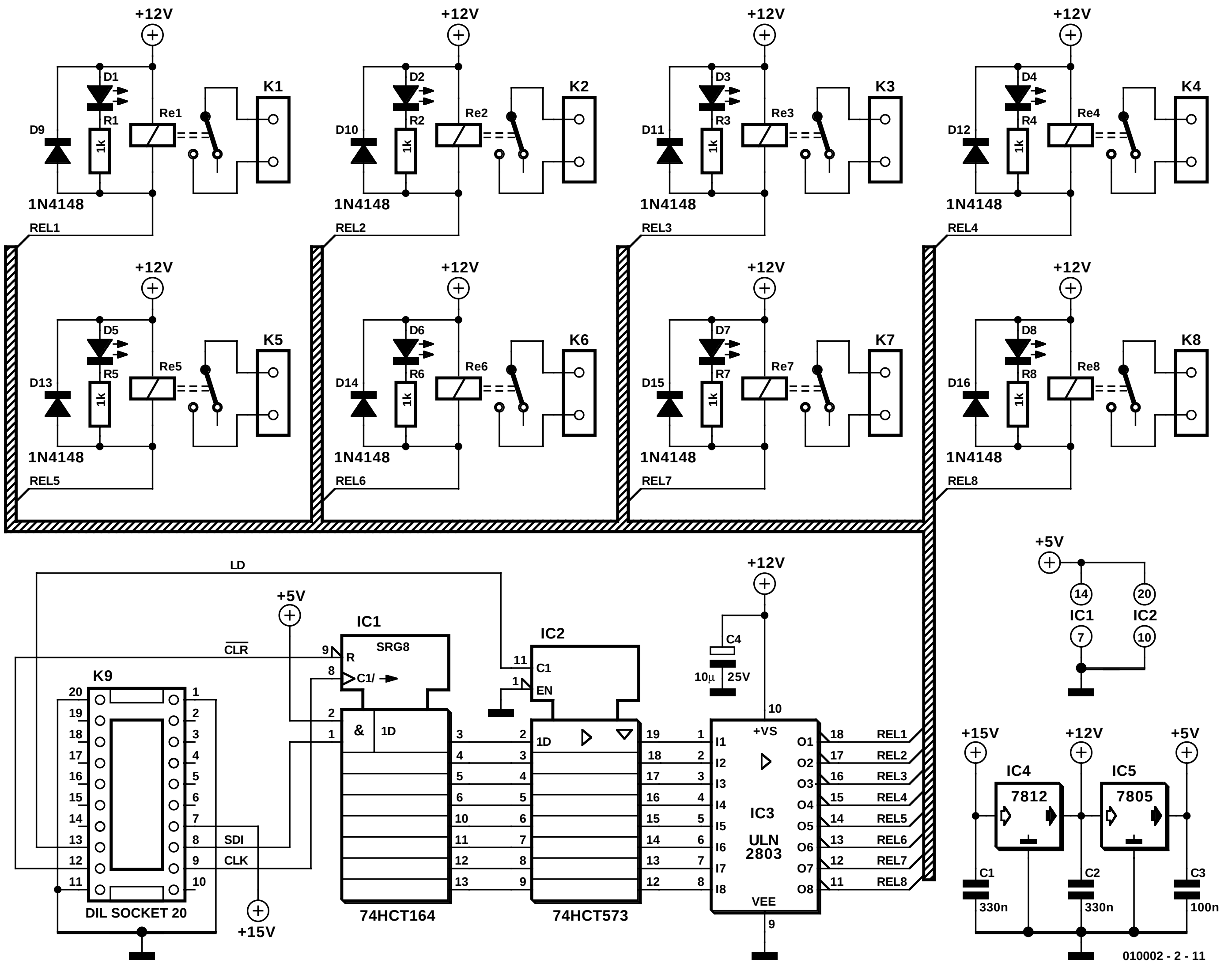


Figure 1. The schematic for the relay extension to the DMX-demultiplexer shows that it is a very straightforward design.

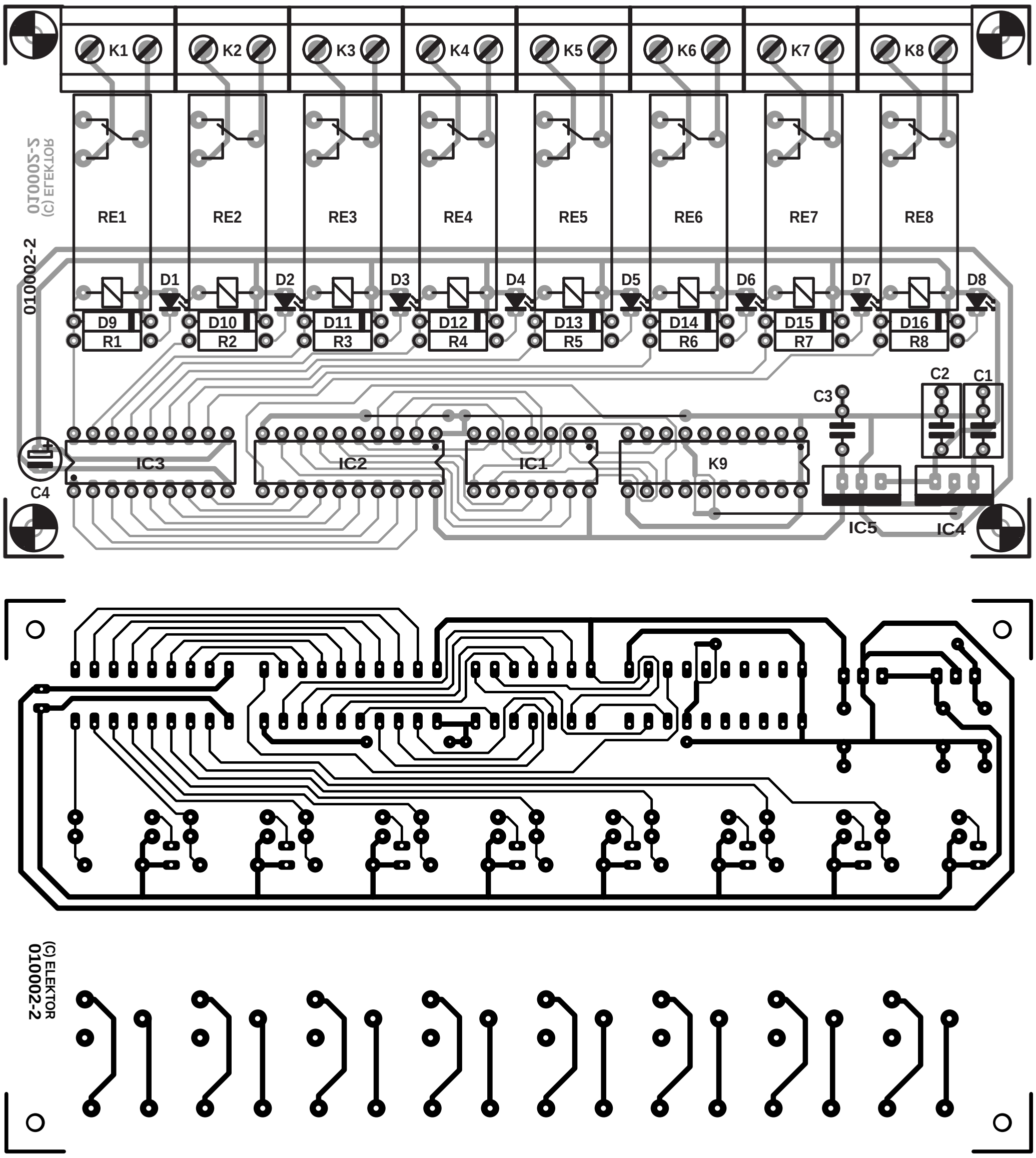


Figure 2. The circuit board for the relay extension contains a number of wire links that must not be forgotten.

LED to indicate the status of the corresponding relay.

The power supply is of a very simple design. Its only task is to convert the 15 V originally intended for the DAC into a voltage that's appropriate for the relay coils (12 V) one of 5 V for the logic circuitry.

Construction

The assembly of the circuit is just as straightforward as the schematic.

As is usual, the ICs are fitted in good quality sockets, after you have checked that the correct power supply voltages are present on the proper pins.

The cable interconnecting the main PCB with the relay extension is best made with DIL20 insulation-displacement connectors (IDC) and a short length of ribbon cable.

COMPONENTS LIST

Resistors:
R1-R8 = 1kΩ

Capacitors:
C1,C2 = 33nF
C3 = 100nF
C4 = 10µF 25V

Semiconductors:
D1-D8 = high-efficiency LED
D9-D16 = 1N4148*
IC1 = 74HCT164
IC2 = 74HCT573
IC3 = ULN2803
IC4 = 7812
IC5 = 7805

Miscellaneous:
K1-K8 = 2-way PCB terminal block, lead pitch 7.5 mm
K9 = 20-pin IC-socket
Re1-Re8 = E-Card relay, 12V, type V23057 B0002 A101 (330 Ω) (Siemens)
Length of 20-way flatcable with DIL20 IDC connectors
PCB no. 010002-2

* D9-D16 may be omitted because the ULN2803 has internal flyback diodes.

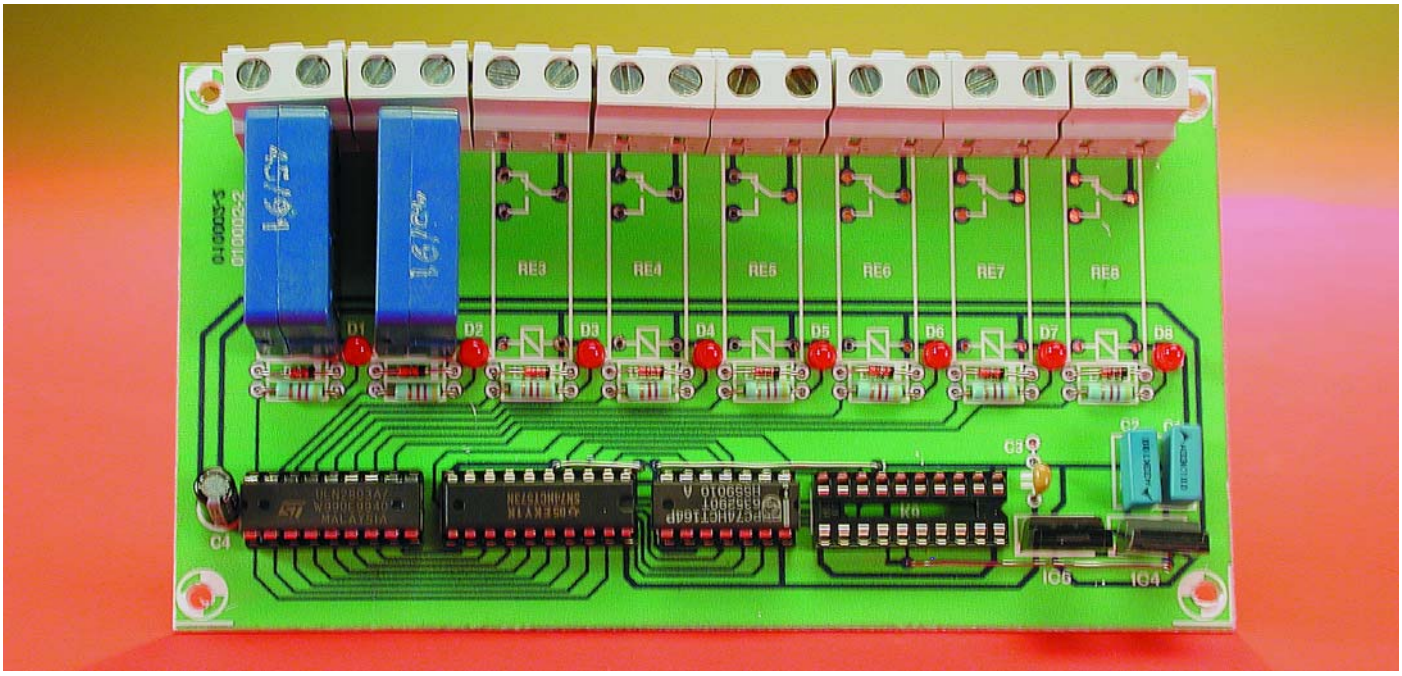


Figure 3. The prototype version shown was populated with just two relays. You are of course free to adjust that number to suit your requirements.

If you are unable to obtain this type of connector, it is also possible to use DIL plugs (intended for soldering components such as resistors and capacitors to) instead. The connections between these two plugs that will function as the interconnecting cable will then have to be built one wire at a time.

The only other thing that requires special attention are the relays Re1 through Re8. The footprint for the relay on the PCB is relatively standard and provides a certain amount of freedom as to the actual model relay that you can use. It is not mandatory to use the exact relay listed in the parts list. However, it is a requirement that you use relays with a low coil current or you will run the real risk of unexpected behaviour when all relays are driven simultaneously and the supply voltage sags as a consequence. We would like to make a concluding remark by saying that it is not necessary to fit all relays — you only need to fit the number required for the application you have in mind.

Connecting up…

Once the wiring for the relay extension has been completed and you have carefully checked it, it can be connected to the socket for the DAC8800, IC4 of the demultiplexer with the DIY ribbon cable. The opamps on the output may also be omitted. One end of this cable is plugged into the empty socket on the extension PCB (refer to illustrating photograph) and the other end is inserted in the socket originally intended for the DAC.

Before applying power to the demultiplexer we have to form the program in the microprocessor that something has changed and that we are not driving the DAC8800 but are using the relay extension instead. To achieve this it is enough to set DIP switch S1-7 on the main PCB in the ON position.

Next, you are ready to apply power. None of the relays should energise. If this happens nevertheless, then carefully check your work again before continuing.

To control the relays you require a DMX Master Device capable of transmitting commands to the channels occupied by the multiplexer (refer to the section about the selection of channels with S1-1 through S1-6 in the original DMX Demultiplexer article).

To activate a relay it is necessary to transmit an instruction for the corresponding channel with a value greater than or equal to 128. To deactivate the relay, issue an instruction with a value between 0 and 127.

…and operating

We leave the practical use of the 'relay' version of our DMX Demultiplexer to the reader/builder. In most cases, it will be sufficient to connect the two wires from the equipment that needs to be controlled, which are usually connected to a switch, to the relay contacts instead.

It is usually quite straightforward to modify existing light fittings that are not remotely controllable with an additional relay to provide them with this feature. Note that the relays in our extension are not capable of switching too large a load.

If you need to switch large loads, we recommend that you use an appropriate external relay, which in turn is controlled by the relay on the extension PCB.

In all cases where large powers are being switched (either via an external relay or directly by Re1 through Re8) you will need to add a so-called 'snubber' network to dissipate the energy that is generated when the contacts are opened.

It is easy to make such a network yourself by connecting a 0.5-watt resistor, with a value of several tens of ohms, in series with a capacitor of about 220 to 330 nF/630 V. This network is then connected directly across the switching contacts of the relay.

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